FACTORS IN LEMNA FERMENTATION PRODUCTIVITY

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ABSTRACT

Fish Feed is an important factor in aquaculture. Lemna sp. is one of the aquatic weeds that can be used as an alternative ingredient for fish feed because of its high nutritional content. The high content of crude fiber in duckweed is one of the obstacles in using Lemna sp. as a fish feed ingredient. This problem can be overcome by fermentation. Fermentation will produce simpler compounds that are easier to digest than before with the help of a fermenter. The lemna fermentation process can be carried out with the help of microorganisms in probiotics. Through the fermentation process, the nutritional content in the lemna changes so that it can be used for various things. Lemna which has gone through the fermentation process can be used as an alternative liquid organic fertilizer to replace commercial fertilizers, can be used as bioethanol because of its high ethanol content, and can be used as an alternative ingredient for fish feed. Factors that affect the productivity of lemna fermentation are time, number of inoculums or doses of probiotics and pH.

Keyword : *Affect, Fermentation, Lemna, Lemna fermentation, Productivity*

1. INTRODUCTION

Feed is one of important factor that must be considered in aquaculture activities. In order for the feed to be utilized properly by the fish's body so that growth can occur, the feed given must be effective and efficient. *Lemna* sp. is one alternative material that can be used as fish feed. Lemna is a small aquatic plant that grows floating on water with a wide distribution rate and has the potential as a source of high quality forage for fish and livestock [1]. According to [2], *Lemna* sp. has non-fibrous roots with a length that varies up to 14 mm depending on the species and environmental conditions. This plant can be found in shallow waters, swamps and lakes [3]. *Lemna* sp. or duckweed often known as water weeds which tend to be difficult to control. Nonetheless, *Lemna* sp. is an aquatic plant that grows floating with a very wide distribution rate and has a high nutrient content [4]. According to [5] the crude protein content in *Lemna* sp. is quite high. Based on [6], *Lemna* sp. has a protein content ranging from 10-45%, 7-14% fiber, 35% carbohydrates, 3-7% fat and a fairly high mineral and vitamin content.

Use of *Lemna* sp. as a vegetable raw material for fish feed is constrained because of the high crude fiber content and the presence of anti-nutritional substances and amino acid composition which is different from animal protein raw materials [7]. Based on [7], the crude fiber content contained in *Lemna* sp. that is equal to 20.08%. The high content of crude fiber in fish feed raw materials can result in a decrease in the digestibility of the feed [4]. To overcome these obstacles, one effort that can be done is fermentation. Through the fermentation process, a compound that is simpler and easier to digest will be produced than before [8]. Based on [9], the quality of fermentation is determined by temperature, pH, nature and composition of the medium, dissolved O_2 and CO_2, and the duration of the fermentation process.

2. LEMNA FERMENTATION

Fermentation is a process of breaking down organic compounds into simpler compounds by involving microorganisms [8]. The principle of fermentation is biological processing by utilizing microbial services, either naturally or through the addition of yeast/mold inoculum [10]. The fermentation process is carried out with the help of a fermenter [11]. According to [12], the microorganisms commonly used in the fermentation process are probiotics. Based on [13], the fermentation process will result in an increase in the nutritional value of the product and the basic properties of the ingredients such as increasing digestibility, removing toxic compounds, enriching the taste and smell that fish like.

Based on [7], lemna fermentation can be carried out by weighing the harvested lemna which has been cleaned and weighed to determine the dose of probiotics to be administered. The lemna that has been weighed is then stored in a plastic bag that has been perforated to obtain aerobic conditions. The next step is to enter a probiotic dose of 5% and then incubate at 34°C for seven days. The success of lemna fermentation is indicated by the characteristic sour smell of fermentation [14]. Based on [13], the nutritional content of *Lemna* sp. before fermentation was 94.12% moisture content, 15.92% ash content, 19.17% protein, 18.37% crude fiber, 2.70% fat and 43.84% carbohydrates. While the nutritional content of *Lemna* sp. after fermentation, namely water content 7.45%, ash content 20.76%, protein 23.47%, crude fiber 13.57%, fat 2.29% and carbohydrates 39.91%.

Fermented lemna can be used in various ways. Research [15] shows that fermented lemna can be used as an alternative liquid organic fertilizer to replace commercial fertilizers with an additional concentration of 5%. Research [16], fermentation of lemna with a yeast content of 25% with a fermentation time of 7 days produces optimum ethanol content. In general, fermented lemna is often used as an alternative ingredient in fish feed. Research [17], the addition of fermented lemna of 2.5% to tilapia feed formulations gave good results so that it can be used in aquaculture in the future. Based on research [18], the utilization of fermented lemna by 20% in gouramy feed provides more optimal results when compared to feeding using soy flour. In addition, research [19] showed the use of fermented lemna as Siamese catfish feed to replace soy flour.

3. FACTORS AFFECTING LEMNA FERMENTATION

Based on [20], the fermentation process can be influenced by various factors such as fermentation time, amount of starter, type of substrate, temperature, oxygen and pH. In addition [9], the microorganisms that will be used in the fermentation affect the product that will be produced. Factors that can affect lemna fermentation are :

3.1 Time

Based on [21], fermentation is affected by time. This is because in the fermentation process, the length of incubation can affect the final product of the fermentation [22]. Fermentation time is a variable related to the microbial growth phase during the fermentation process so that it will affect the fermentation results [21]. The length of incubation is related to the time that can be used by microbes to grow and decompose the substrate [22]. In the lemna fermentation process, the fermentation time affects the nutritional value of the lemna. Based on [23], the lemna fermentation process for 24 hours was able to increase crude protein from 18.19% to 19.07% and reduce crude fiber from 15.1% to 3.60%. In addition, based on [24], the lemna fermentation process for seven days was able to increase crude protein by 5.60% and reduce crude fiber by 15.27%. According to [25], the longer the incubation time, the higher the crude protein content. In addition to increasing the nutritional content of lemna, the fermentation time of seven days produced the most optimum ethanol content compared to the shorter time, which was 3.81% [15]. This is because in lemna fermentation for the bioethanol production process the longer the fermentation time, the higher the bioethanol content produced [15].

3.2 Number of Inoculums or Dosage of Probiotics

The number of inoculums affects the final product of fermentation [11][22]. This is because the dose level is related to the size of the microbial population which has the opportunity to determine the speed of microbial development which will further decompose the substrate thereby affecting the final product [22]. According to [23], the greater the number of inoculums used, the shorter the time needed to increase the crude protein content. The selection of the fermentation time and the determination of the right amount of inoculum are the determining factors for the crude fiber content that will be produced from the fermentation process [26]. This is supported by [27], namely an increase in the amount of microbial mass will lead to an increase in the protein content of the fermented product. In line with

[28], an increase in the percentage of additional doses of fermented probiotics will be accompanied by an increase in changes in crude protein while crude fiber will decrease.

Increase in the number of *Trichoderma harzianum* inoculums on lemna fermentation will increase protein [26]. Based on [23] the lemna fermentation process with the amount of *Trichoderma harzianum* inoculum of 3.10^7 able to increase the crude protein content and reduce the crude fiber content more optimally when compared to the number of *Trichoderma harzianum* inoculums of 1.10^7 and 2.10^7. Based on [28], fermented lemna with a percentage addition of a probiotic dose of 5% gave a better change in nutrition when compared to the percentage of an additional dose of probiotics of 1% and 3%. Changes in crude fiber in lemna that have gone through the fermentation process occur due to the activity of the bacteria found in the probiotics used.

3.3 pH

pH is an important factor in the fermentation process because pH affects the conditions for microbial growth [29]. According to [30], pH relates to the degree of acidity of the medium which will determine the activity of microorganisms. The lemna fermentation process to produce bioethanol is carried out at a pH of 4.5, this is because the bacteria can convert glucose from *Lemna* sp. well [31]. pH affects the activity of microorganisms. Too low (acidic) and high (alkaline) pH can trigger microbial cell death [30]. The high level of microbial death can affect the speed of fermentation because the number of microbes to break down glucose is reduced. In addition, [32] the optimum pH value also affects microbial growth. In general, microbes can grow at a pH ranging from 3–6.

4. CONCLUSION

The high content of coarse fiber in *Lemna* sp. becomes an obstacle in its utilization as an alternative ingredient for fish feed. This problem can be overcome by fermentation. *Lemna* sp. which has gone through the fermentation process can be used as an alternative liquid organic fertilizer to replace commercial fertilizers, a source of bioethanol and an alternative ingredient for fish feed. However, in the fermentation process, the productivity of *Lemna* sp. fermentation is influenced by time, the amount of inoculum or probiotic dose and pH.

5. REFERENCES

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